Methods And Devices For Controlling The Connection Of Power Supplies To Circuitry Within Rechargeable Devices

Cannon 94-85-17-44

ABSTRACT OF THE DISCLOSURE

Circuitry within a rechargeable device, such as a cordless telephone handset, may be powered even when a battery which normally powers the circuitry has lost power. A device or method allows for the connection of a base power supply to power the circuitry when the handset is placed into an in-cradle state. The device or method monitors the power level of the battery and when the power drops below a sufficient level, the device or method disconnects the battery and connects the base power supply. The circuitry is then powered until the handset's battery has been recharged. The ability to power the circuitry while its' battery is being recharged permits the handset to carry out functions which would not otherwise be possible until the battery has been completely recharged.

BACKGROUND OF THE INVENTION

Few would deny the advantages offered by devices which are powered by batteries versus those which need to be physically connected to a power supply or an electrical outlet. The communications industry has moved rapidly to introduce both cordless and wireless devices designed to run primarily on batteries. As anyone who has used a battery powered device knows, though, batteries run down and need to be replaced or recharged. One type of rechargeable device is a cordless telephone. There exists cordless telephones which are made

up of a base and a handset. Typically, the handset is powered by a battery of some sort. When the battery runs down most telephones allow the handset's battery to be recharged by placing it into the base. This is referred to as placing the handset into the cradle of the base (hereafter an "in cradle" state). Once the battery in the handset has been recharged the handset can be taken out of the base and used. This is referred to as taking the handset out of the cradle (hereafter "out of cradle" state). During the time the handset is in the in-cradle state and its' battery is recharging the handset cannot be used for incoming or outgoing telephone calls. In addition, most telephones are not designed to allow the handset to communicate with the base in order to exchange registration information nor do they allow secondary features, such as caller-identification, to function until the battery is sufficiently recharged.

It is desirable to have a rechargeable device, such as a cordless telephone handset, which could operate while its' battery is recharging from a dead battery state.

Accordingly, it is an object of the present invention to provide for methods and devices for controlling the connection of a power supply or supplies to circuitry of a rechargeable device, such as a cordless telephone handset, to allow the circuitry to operate while a battery is recharging.

Other objectives, features and advantages of the present invention will become apparent to those skilled in the art from the following description taken in conjunction with the accompanying drawings.

SUMMARY OF THE INVENTION

In accordance with the present invention there are provided devices and methods for controlling the connection of a power supply or supplies to circuitry of a rechargeable device, such as a cordless telephone handset, to allow the circuitry to operate while the handset's battery is being recharged. Though the following discussion will focus on cordless telephones, it should be understood that the present invention is not so limited. Rather, the present invention applies to other rechargeable devices, such as wireless telephones, as well.

An illustrative embodiment of the present invention comprises a detection unit adapted to detect power levels of a handset battery and a power control unit adapted to connect or disconnect a power supply depending on the power level detected by the detection unit. If the detection unit determines that the handset's battery is running low on power it informs the control unit which disconnects the handset circuitry from the battery and places the circuitry into a dormant mode. Once the handset has been placed into the cradle of a complimentary base, the control unit is then adapted to connect the circuitry to a base power supply, such as an AC or DC (e.g., battery) supply. The control unit is also adapted to place the circuitry in an active mode. The circuitry remains connected to the base power supply until such time as the battery has recharged. Once the battery has been recharged the control unit is then adapted to disconnect the circuitry from the base power supply and reconnect it to the handset battery.

The present invention and its advantages can be best understood with reference to the drawings, detailed description of the invention and claims that follow.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 depicts a device for controlling the connection of a power supply or supplies to circuitry of a rechargeable device, such as a cordless telephone handset, to allow the circuitry to operate while a battery is recharging.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 shows a device 12 for controlling the connection of a power supply 14a or 14b to handset circuitry 13 of a cordless telephone handset. FIG. 1 does not show all of the component parts of a cordless telephone handset, but it should be understood that the device 12, circuitry 13, handset battery 14a and diode 15 are some of the parts making up such a handset. As stated before, though the following explanation will assume that the device 12 is a part of a cordless telephone which includes a handset and base the present invention is not so limited. The device 12 may also be part of a number of rechargeable devices, such as a wireless telephone. In the explanation and examples which follow the word "circuitry" will be used to refer to components which are responsible for sending or receiving telephone calls, the registration process between the handset and its complimentary base and caller-identification processing to name just a few functions carried out by such circuitry.

One example of how the device 12 operates to control the connection of power supplies, and thus power, to circuitry 13 is as follows.

In an illustrative embodiment of the invention, the device 12 comprises a detection unit or means 2 connected to the terminals of handset battery 14a. The detection unit 2 is adapted to detect power levels of the battery 14a. After detecting certain power levels the detection unit 2 is further adapted to output signals via pathway 8 to a power control unit or means 1. More specifically, the detection unit 2 is adapted to detect a low power level of the battery 14a. In one embodiment of the present invention this low power level comprises a power level which is insufficient to power the circuitry 13. The detection unit 2 is likewise adapted to detect a sufficient power level, which is a power level which is sufficient to power the circuitry 13.

If the detection unit 2 detects a low power level it is adapted to output a first signal via pathway 8 to the power control unit 1. The power control unit 1 is adapted to receive the first signal and is further adapted to disconnect the handset battery 14a from circuitry 13. Once the battery 14a is disconnected from the circuitry 13 there is no longer a load on the battery 14a. This disconnection may result in a small increase in battery power being detected by the detection unit 2. Those skilled in the art may refer to this increase as "bounce back". In an alternative embodiment of the invention the detection unit 2 is further adapted to continue to output the first signal until the detected level reaches a sufficient power level even after the load is disconnected from the battery 14a. Said another way, the detection unit 2 is further adapted to ignore the small increase in power seen when the circuitry 13 is disconnected and continues to output the first signal. The reason for ignoring this increase is to avoid the possibility that the detection unit 2 may interpret the small increase as an indication that the battery 14a is sufficiently charged when, in fact, it is not.

Before going further, it should be understood that when "connection" or "disconnection" of the circuitry 13 or a power source is described, the connection/disconnection may be between the power control unit 1 and the circuitry 13 or between the power control unit 1 and the power source; both types of connections/disconnections are envisioned by the present invention.

In an illustrative embodiment of the invention, the detection unit 2 may be adapted to store at least a set of reference power levels. The first reference level is a level which is insufficient to operate the circuitry 13; the second reference level is a power level sufficient to operate the circuitry 13. These two levels are separated by an amount which is greater than the maximum bounce back level seen by the battery 14a. For example, if the first level is 3 volts the second level may be 3.5 volts. Thus, the detection unit 2 would be set to output the first signal when the battery's 14a voltage becomes equal to or less than 3 volts. At this level the power control unit 1 would disconnect the battery 14a from the circuitry 13. The battery 14a would then see a bounce back voltage, for example, an increase of 0.1 volts. The detection unit 2 would then detect a new voltage of 3.1 volts. Because this voltage is less than 3.5 volts, the detection unit 2 will not output a second signal along pathway 8 to the power control unit 1. Only when the battery voltage rises above 3.5 volts will the detection unit 2 output a second signal indicating that the battery 14a has been recharged.

Though the low power level described above is a level which is insufficient to power the circuitry 13, it should be understood that this level may also comprise another level set by the user or manufacturer of the handset for a particular application or feature. The above example illustrates the concept of hysteresis. The voltage levels are just one example of the levels which may be used.

Continuing, in addition to disconnecting the battery 14a, the power control unit 1 is further adapted to output a reset signal via pathway 6 or 7 to place the circuitry 13 in a first or reset mode. In one embodiment of the invention the handset is in an out-of-cradle state. In this state the power control unit 1 is adapted to place the circuitry 13 in the first mode of operation. Because the handset is in an out-of-cradle state and because its' battery 14a has run down, the first mode will most commonly comprise a "dormant" state; that is a state where the circuitry 13 is placed into a mode where its operation is suspended. As indicated in FIG. 1, the power control unit 1 is adapted to receive signals along pathways 9 and 10 indicating whether the handset is in an in-cradle or out of cradle state. In an alternative embodiment of the present invention, the power control unit 1 is further adapted to place the circuitry 13 in a second mode of operation when the handset is in an in-cradle state. As will be explained shortly, when the handset is placed into the cradle of the base, power is supplied to the circuitry 13 from the base. The power control unit 1 is adapted to detect when the handset has been so cradled and is further adapted to remove the reset signal present on pathway 6 or 7. This places the circuitry 13 in an "active" state; that is a state where the circuitry 13 is placed into a normal mode of operation. It should be understood that the power control unit 1 may place the circuitry 13 in either of the two modes depending on whether the handset has been cradled or not.

The explanation just given assumes that the reset function and signals are carried out by the power control unit 1. This may or may not be the case. In an alternative embodiment of the invention, the device 12 further comprises a separate reset unit or means 15 which may or may not be a part of power control unit 1(as indicated by the dotted lines in FIG.1). The reset unit 15 is adapted to carry out all of the reset functions described above with respect to the power control unit 1.

Backtracking a little, as long as the handset is in an out of cradle state and the battery 14a has reached a low power level the battery 14a will be disconnected from circuitry 13. In fact, as long as these two conditions exist the circuitry 13 will not be connected to any source of power.

This changes when the handset is cradled. Upon cradling, the power control unit 1 is adapted to detect a voltage across diode 15 indicating that the handset has been cradled. The power control power unit 1 is then adapted to connect the circuitry 13 to handset charging contacts 3a, 4a which have been cradled or connected to base charging contacts 3b, 4b. Because the base charging contacts 3b,4b are connected to a base power supply 14b, it can be said that the power control unit 1 is effectively adapted to connect the circuitry 13 to the base power supply 14b when the handset is placed in an in-cradle state. In one embodiment of the invention the base power supply 14b comprises a base battery or another DC power supply. In still another embodiment of the invention, the base power supply 14b comprises an AC power supply.

The power control unit 1 may be adapted to perform other functions other than connection/disconnection, detection of a cradling state and resetting the circuitry 13. For example, in a further embodiment of the present invention the power control unit 1 is adapted to provide regulated power to the circuitry 13 when the circuitry 13 is connected to the handset battery 14a or base power supply 14b.

Referring back to FIG.1, it can be seen that the handset battery 14a is connected to the handset charging contacts 3a,4a. Thus, when the handset is cradled and base power is applied to the handset charging contacts 3a,4a the battery 14a begins to charge (or recharge). At some point the battery 14a obtains a charge sufficient enough to operate the circuitry 13. The detection unit 2

is adapted to detect such a sufficient power level of the battery 14a and is then further adapted to output a second signal along pathway 8 to the power control unit 1. Upon receiving the second signal, the power control unit 1 is adapted to disconnect the base power supply 14b from circuitry 13 and to connect the handset battery 14a to circuitry 13.

As with the low power level, it has been assumed that the "sufficient power level" is one which is needed to operate the circuitry 13. In alternative embodiments of the invention, the sufficient power level may comprise other levels, such as one above a bounce back voltage level but lower than a level needed to power all of the components of circuitry 13. Said another way, the sufficient power level may comprise a level sufficient to operate some of the components, or to carry out some of the functions of, circuitry 13.

FIG. 1 shows the detection unit 2 and control unit 1 as block diagrams. It should be understood that although these units are shown as separate units they may be combined into one unit or further broken down into a number of units. In addition, these units may comprise a number of components. For example, in one embodiment of the invention, the power control unit 1 may comprise programmable units such as microprocessors or digital signal processors. In another embodiment the power control unit 1 comprises first and second regulators or regulator means adapted to carry out the same functions as described above.

By way of illustration, a first voltage regulator can be adapted to connect and/or disconnect the handset battery 14a from circuitry 13 while a second voltage regulator can be adapted to connect and/or disconnect charging contacts 3a,4a from circuitry 13 in order to connect/disconnect the base power supply 14b from circuitry 13.

More specifically, the first voltage regulator can be connected to the handset battery 14a and adapted to receive the second signal indicating the battery 14a is charged. The first voltage regulator can then be further adapted to connect the circuitry 13 to the handset battery 14a. In an alternative embodiment of the invention the first voltage regulator can be adapted to supply the circuitry 13 with regulated power from the battery 14a. If the detection unit 2 sends the first signal to the power control unit 1 indicating a low power level of the battery 14a, then the first voltage regulator can be further adapted to receive this first signal and to disconnect the handset battery 14a from circuitry 13.

We now turn to the second voltage regulator. The second voltage regulator can be connected to the handset charging contacts 3a,4a. When the handset is placed into an in-cradle state the second voltage regulator can be adapted to connect the circuitry 13 to the charging contacts 3a,4a. As before, this connection in turn allows the circuitry 13 to be connected to the base power supply 14b. As with the first voltage regulator, the second voltage regulator can be adapted to provide regulated power to the circuitry 13. Unlike the first voltage regulator, however, the second voltage regulator is adapted to provide regulated power from the base power supply 14b, not from the handset battery 14a.

The ability to supply the circuitry 13 with power when it is in an in-cradle state enables the circuitry to carry out a number of functions not normally possible when its own battery runs down. For example, the power supplied to the circuitry 13 may allow the circuitry to: (a) initiate a registration process between the handset and base; (b) initiate "quick charge" processes to hasten the charging of the battery 14a; (c) receive and display caller-identification information; (d) in the case where the handset is cradled to allow a user to access a keypad, enable the

circuitry to work with the base in order to send or receive telephone calls while the handset is cradled in conjunction with a speakerphone located within the base; or (e) to send/receive commands to/from a telephone answering machine/device, to give just a few examples. It should be understood that these examples are by no means an exhaustive list of the types of functions which may be carried out by circuitry 13.

The first and second signals sent by the detection unit 2 can be used to carry out additional features besides the connection/disconnection of power supplies/handset circuitry. For example, in an alternative embodiment of the invention, the device 12 may comprise an output unit or means 16 adapted to receive the first and second signals along pathway 8a and further adapted to output an indication, such as a message or warning, indicating whether the battery 14a has been recharged (e.g., "do not remove handset until battery is charged"). Alternatively, the output unit 16 can be adapted to output an audio, video or similar signal indicating the recharging status of battery 14a. The output unit 16 can comprise any number of LED, LCD displays and/or audio components and the like to carry out the functions just described and may or may not be a component part of the device 12 (as indicated by the dotted lines).

Though the description above has focused on devices, the present invention also envisions methods for controlling the connection of power supplies to rechargeable devices.

It is to be understood that changes and variations may be made without departing from the spirit and scope of this invention as defined by the claims that follow.